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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

VINH, LAN

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 12/26/2002

13

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/662,682

Applicant(s)

LI ET AL.

Examiner

Lan Vinh

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-- The MAILING DATE of this communication appears on the cover sheet with the corresponding address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-11 and 21 is/are rejected.
- 7) ☒ Claim(s) 12-20 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ 6) ☐ Other: ____

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DETAILED ACTION

Continued Prosecution Application

1. The request filed on 11/27/2002 for a Request for Continued Examination (RCE) under 37 CFR 1.114 based on parent Application No. 09/662682 is acceptable and a RCE has been established. An action on the RCE follows.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 21 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The limitation of "a thickness sufficient to permit nucleation that forms nanometer size metal particles and small enough to prevent formation of a continuous metal layer" has no positive support in the specification.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1, 11 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In line 3 of claims 1 and 11, the claim language of " a thin discontinuous layer of metal" is vague and indefinite because the term "discontinuous layer of metal " is not defined in the specification.

3. For the purpose of examination, the claim language of "a thickness sufficient to permit nucleation that forms nanometer size metal particles and small enough to prevent formation of a continuous metal layer" is best understood by the examiner as a thickness in the nanometer size, the claim language of " a thin discontinuous metal layer" is best understood by the examiner as a thin metal coating on Si appear as nanometer size islands, as disclosed in page 7 of the specification.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-2, 4, 5,10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Winton et al (US 6,017,811) in view of Bohara et al (US 5,089,293)

Winton discloses a method for making improved electrical contact to porous silicon. This method comprises the steps of:

forming a conductive layer 56 of gold (Au)/metal on a Si substrate 54 (col 3, lines 39-40; col 4, lines 65-66 and fig. 3)

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forming a porous silicon 52 by subjecting the Si substrate 54 to stain etch using a solution of HF and HNO_3 (nitric acid)/oxidizing agent, the stain etch does not require electrically bias (col 3, lines 21-59; col 4, lines 1-2, lines 54-59) which reads on forming the porous silicon by etching the Si surface in a HF and oxidant solution, the etching being conducted without external electrical bias.

Winton differs from the instant claimed invention as per claim 1 by depositing a metal film instead of a thin discontinuous layer of metal/ a thin metal coating on Si appear as nanometer size island on a Si surface.

However, Bohara discloses a method for forming a platinum thermometer comprises the step forming a thin metal coating (platinum) 36 and 38 appears as island (having a thickness of 17000 angstroms/1700 nm) on a silicon surface 28 before etching the surface 28 with a solution of HF (col 8, lines 60-62, col 9, lines 10-13 and fig. 2F) which reads on forming a thin metal coating appear as nanometer size island on a silicon surface.

Since Winton is concerned with a method of making porous silicon by etching a silicon/Si surface formed under a metal layer using HF solution one skilled in the art would have found it obvious to modify Winton step of forming a metal layer on a Si surface by forming a thin metal coating appear as nanometer size island on a silicon surface/ a thin discontinuous layer of metal as per Bohara because according to Bohara the thin metal coating is generally sufficiently porous so that a liquid etchant (HF) will penetrate the thin strip layer/silicon surface 28 that formed under the thin metal coating (col 9, lines 10-14)

Regarding claim 2, Winton is silent about the use of illumination during the etching step which reads on the step of etching is conducted in the absence of illumination.

The limitation of using Platinum (Pt) as the metal formed on the Si surface, as recited in claim 4, has been discussed above.

Regarding claim 5, Winton discloses that the conductive layer 56/metal layer comprises of gold (Au) (col 4, lines 65-66)

Regarding claim 10, Winton discloses performing the etching for 15 minutes, 30, 45 and 60 minutes (col 3, lines 64-65) which reads on the claimed range of between about 2 seconds and one hour (60 minutes)

6. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winton et al (US 6,017,811) in view of Bohara et al (US 5,089,293) and further in view of Russell et al (US 6,093,941)

Winton as modified by Bohara has been described above in paragraph 5. Winton and Bohara differ from the instant claimed invention as per claim 3 by conducting the etching without the illumination instead of conducting the etching in the presence of illumination.

However, Russell, in a method of forming porous region in a light emitting silicon structure, teaches that luminescent porous silicon can be produced using either chemical stain etch (without illumination) or photochemical etch (with illumination) (col 6, lines 65-67; col 7, lines 10-12)

Hence, one skilled in the art would have found it obvious to modify Winton and Bohara etching step to form porous silicon by conducting the etching in the presence of illumination in view of Russell teaching because Russell discloses that as the illumination time during etching increases, the etching spreads out to regions of the silicon which were not illuminated and small etched features becomes washed out consistent with the generation of holes/pores required for the catalysis of the etching mechanism (col 6, lines 9-13)

7. Claims 6, 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Winton et al (US 6,017,811) in view of Bohara et al (US 5,089,293) and further in view of Yoshikawa et al (US 5,990,605)

Winton as modified by Bohara has been described above in paragraph 5. Winton and Bohara differs from the instant claimed invention as per claim 6 by depositing a metal layer of gold (Au) instead of Pd (Palladium)

However, Yoshikawa, in a method of forming an electron emission device include a porous semiconductor, discloses that Au or Pd can be used as metal coating on a porous silicon surface 13 (col 7, lines 31-35)

Hence one skilled in the art would have found it obvious to substitute Winton and Bohara metal layer of Au with Pd in view of Yoshikawa teaching because both Au and Pd are known metals for using as a metal coating on a porous surface, thus the substitution of one for the other would have produced an expected result.

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Unlike the instant claimed invention as per claim 7, Winton and Bohara do not specifically disclose forming a combination of metals selected from the group consisting of :Au, Pt and Pd.

Yoshikawa also discloses that metals of Au, Pt and Pd can be used as an alloy metal coating on a porous silicon surface 13 (col 7, lines 31-37) which reads on using a combination of metals selected from the group consisting of :Au, Pt and Pd.

Hence one skilled in the art would have found it obvious to modify Winton and Bohara metal layer by forming an alloy metal layer as per Yoshikawa because Yoshikawa states that an alloy/combination of metal contain Au and Pt is desirable to make the thin film metal very thin to increase electron emission (col 7, lines 45-49)

8. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winton et al (US 6,017,811) in view of Bohara et al (US 5,089,293) and further in view of Hwang et al (US 4,681,657)

Winton as modified by Bohara has been described above in paragraph 5. Winton and Bohara differ from the instant claimed invention as per claim 8 by by etching using HF and an oxidant of HNO₃ instead of HF and an oxidant H₂O₂.

However, Hwang discloses that HNO₃ and H₂O₂ can be used as oxidizer/oxidant in a HF solution that is used to wet etch silicon wafer (col 1, lines 8-14)

Hence, one skilled in the art would have found it obvious to substitute Winton and Bohara etching solution of HF and HNO₃ with etching solution of HF and H₂O₂ in view of Hwang teaching because both etching solutions have the same function of wet

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etching silicon ; therefore, the substitution of one for the other would have produced an expected result.

9. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winton et al (US 6,017,811) in view of Bohara et al (US 5,089,293) and further in view of Yoshikawa et al (US 5,990,605)

Winton as modified by Bohara has been described above in paragraph 5.

Although Winton and Bohara discloses forming a thin metal coating of Pt on the silicon surface, Winton and Bohara does not specifically disclose that the thickness of the metal is less than approximately 10 nm.

However, Yoshikawa discloses a method of forming an electron emission device include a porous semiconductor comprises the step of forming a thin (thickness of 2 nm)/less than approximately 10 nm metal layer 15 on a porous silicon surface 13 (col 7, lines 51-54)

Since Winton and Bohara discloses forming a thin metal coating of Pt, one skilled in the art would have found it obvious to modify Winton and Bohara metal forming step by forming a thin metal layer having the thickness as taught by Yoshikawa because according to Yoshikawa when considering the stability as an electron/light emission device a thin (2nm) is the most suitable for the Au or Pt thin film/coating on a porous surface (col 7, lines 53-55)

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10. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Winton et al (US 6,017,811) in view of Bohara et al (US 5,089,293)

Winton discloses a method for making improved electrical contact to porous silicon. This method comprises the steps of:

forming a conductive layer 56 of gold (Au)/metal on a Si substrate 54 (col 3, lines 39-40; col 4, lines 65-66 and fig. 3)

forming a porous silicon 52 by subjecting the Si substrate 54 to stain etch using a solution of HF and HNO₃(nitric acid)/oxidizing agent, the stain etch does not require electrically bias (col 3, lines 21-59; col 4, lines 1-2, lines 54-59) which reads on forming the porous silicon by etching the Si surface in a HF and oxidant solution, the etching being conducted without external electrical bias. Winton also discloses performing the etching for 15 minutes, 30, 45 and 60 minutes (col 3, lines 64-65) which reads on the claimed range of between about 2 seconds and one hour (60 minutes)

Winton differs from the instant claimed invention as per claim 21 by depositing a metal instead of depositing metal in the nanometer size thickness/ in a thickness sufficient to permit nucleation that forms nanometer size metal particles and small enough to prevent formation of a continuous metal layer

However, Bohara discloses a method for forming a platinum thermometer comprises the step forming a thin metal coating (platinum) 36 and 38 (having a thickness of 17000 angstroms/1700 nm) on a silicon surface 28 before etching the surface 28 with a solution of HF (col 8, lines 60-62, col 9, lines 10-13 and fig. 2F) which reads on forming a metal in the nanometer size thickness on a silicon surface.

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Since Winton is concerned with a method of making porous silicon by etching a silicon/Si surface formed under a metal layer using HF solution one skilled in the art would have found it obvious to modify Winton step of forming a metal layer on a Si surface by forming a metal in the nanometer size thickness on a silicon surface as per Bohara because according to Bohara the thin metal coating (nanometer size) is generally sufficiently porous so that a liquid etchant (HF) will penetrate the thin strip layer/silicon surface 28 that formed under the thin metal coating (col 9, lines 10-14)

Allowable Subject Matter

11. Claim 11 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action.

Claims 12-20 are objected as being dependent upon a rejected base claim, but would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

The cited prior art of record fails to disclose a method for producing porous silicon consisting of the recited steps in claim 11. The closest cited prior art of Winton et al (US 6,017,811) discloses a method for producing porous silicon comprising the recited steps in claim 1 and additional steps of immersing the silicon surface in DI water and drying the silicon surface with nitrogen.

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Response to Arguments


12. The argument that the claims clearly define that the layer of metal is first deposited on an Si surface and then the Si surface is etched to form the porous silicon does not commensurate with the scope of claims 1, 11 and 21 because the term "first deposited on a Si surface" and "then the Si surface " are not recited in the claims.

Conclusion

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 703 305-6302. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872-9310 for regular communications and 703 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308-0661.


LV

December 20, 2002